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Conservation Assessment

for the

False Hop Sedge

(Carex lupuliformis Sartwell ex Dewey)

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ILLINOIS
NATURAL
HISTORY
SURVEY

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Carex lupuliformis Sartwell ex Dewey, from Atlas of Florida Vascular Plants. Photograph by Shirley Denton.

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EXECUTIVE SUMMARY

This Conservation Assessment is a review of the taxonomy, distribution, habitat, ecology, and status of the False Hop Sedge, *Carex lupuliformis* Sartwell ex Dewey, throughout the United States and Canada, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about potential threats and conservation efforts regarding this sedge to date. The False Hop Sedge is a tufted, rhizomatous sedge that grows up to 130 cm tall. There is only the typical variety and it has been found in twenty-three to thirty-one states and in two Canadian provinces, from Maine to Minnesota south to Texas and Florida, and in limited adjacent portions of Quebec and Ontario. It grows mainly in seasonally inundated swamp forests. It appears to reproduce normally by seed but it can also propagate by its extensive rhizome system. One of the greatest difficulties in working with this plant is the difficulty with identification, and this has resulted in some confusion as to the exact range and status of the species. Globally, its ranking is G4 or G3G4, indicating uncertainty as to whether the species is globally threatened or apparently secure. *Carex lupuliformis* has been listed as Endangered in CT, MA, NJ, and WS and as Threatened in MI and OH. This sedge has been designated as either Rare or of Special Concern in IN, IA, and NY. In AR, *Carex lupuliformis* is tracked and is included on the list of State Species of Special Concern. This sedge is considered to be vulnerable in Illinois, but it is not listed as threatened or endangered nor is it tracked in the state. *Carex lupuliformis* has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) in the Shawnee National Forest (IL) and the Finger Lakes National Forest (NY). It has not been included on the RFSS list for the Hoosier National Forest, where it has not been found. It is considered at risk in these forests because of its scarcity in the Midwest. It is known from several southern national forests.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the entity throughout its range within a given planning area.

The objectives of this document are to:

-Provide an overview of the current scientific knowledge on this species.

-Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.

-Provide the available background information needed to prepare a subsequent Conservation Approach.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Carex lupuliformis* Sartwell ex Dewey [1850]
Common Names: False Hop Sedge; False Hop-sedge; Hop-like Sedge; Knobbed Hop Sedge; Mock Hop Sedge
Synonymy: *Carex lupulina* Muhl. ex Willd. var. *polystachia* Schweinitz & Torr. [1825]
Carex lurida Wahlenb. var. *polystachia* (Schweinitz & Torr.) L.H.Bailey [1886]
Carex gigantea Rudge f. *minor* Farw. [1921]

Class:	Liliopsida (Flowering Plants - Monocotyledons)
Family:	Cyperaceae (The Sedge Family)
Plants Code:	CALU3 (USDA NRCS plant database, W-1) http://plants.usda.gov/

The sedge genus *Carex* contains about 480 species in North America north of Mexico, according to Ball and Reznicek (2002). The genus is one of the largest within the flowering plants with about 2,000 species worldwide. The species are widespread and most common in wet or moist, cooler regions of the Northern Hemisphere, and few occur in tropical lowlands or in sub-Saharan Africa. In most northern and eastern North American states and Canadian provinces, *Carex* is the most species-rich genus present.

The False Hop Sedge was named *Carex lupuliformis* by Sartwell [published by Dewey in 1850], who recognized that the spikes are quite reminiscent of the spikes of *Carex lupulina* Willd., which, in turn, has spikes reminiscent of Hops (*Humulus lupulus*) and so he used this epithet. This species appears to have been based upon the earlier name *Carex lupulina* Muhl. ex Willd. var. *polystachia* Schweinitz & Torrey [1825]. While first described by Linnaeus in 1753, the name *Carex* is somewhat obscure in origin, some saying that it was derived from the Greek *keirein*, to cut, on account of the normally very sharp edged leaves. In the subsequent years the large genus *Carex* was redefined several times, and, currently, the species is generally placed within *Carex* section *Lupulinae* Tuckerman ex J. Carey (Reznicek 2002). The inflated perigynia (which enclose the fruits) of the members of this section are the largest (longest) of the midwestern sedges. This species is thought to be closely related to several other species in the same section, including *Carex gigantea* Rudge, *Carex grayi* J.Carey, *Carex intumescens* Rudge, *Carex louisianica* L.H.Bailey, and *Carex lupulina* Willd. The ranges of all six species significantly overlap, and both *C. gigantea* and *C. lupulina* are often very similar in appearance to the False Hop Sedge. Several botanists have considered it to be extremely similar to *C. lupulina, C. lurida*, and *C. gigantea*, and the False Hop Sedge has been placed within these other species by some (*e.g.*, Godfrey and Wooten 1979; Smith 1978 who consider it to be the same as *C. lupulina*). It is more generally considered to be taxonomically distinct from the other species in its section and is not known to hybridize with them. However, while the proposal is somewhat controversial, *Carex lupuliformis* is thought by some to hybridize with *Carex retrorsa*

Schweinitz, a species in the similar *Carex* section *Vesicariae* (Heuffel) J.Carey, and this hybrid has been named *Carex* X *macounii* Dewey (W-2; Fernald 1950). Several forms have been described for this species, but none are currently accepted.

Most species of *Carex* are simply called 'sedge' because of their similarity to one another. It is only in recent years that there has been an attempt to standardize the common names of the individual species. The common name False Hop Sedge has been used by Kartesz and Meacham (1999) and appears to be gaining acceptance.

DESCRIPTION OF THE SPECIES

Carex lupuliformis Sartwell ex Dewey, the False Hop Sedge, is a herbaceous, rather robust, long-lived perennial sedge, loosely clumped or not (stems sometimes single and scattered but the clumps are usually connected by rhizomes), fibrous-rooted, with 4-7 **leaf blades** 30-80 cm long x 6-13 mm wide, and the plant has a total culm height of (40-) 50-130 cm. The flowering stems are 1 to few per tuft, smooth, and light brown to somewhat reddish tinged at their bases (lower sheaths). The vegetative stems are generally poorly developed or absent. The **rhizomes** are dark brown, well developed, and the plant can be described as long-rhizomatous (though some have described it as arising from a short thick rootstock). The basal leaf sheaths are reddish to pale brownish and not fibrous, and are slightly prolonged beyond the attachment of the blades; the uppermost leaf has a sheath 3-21 cm long. The **leaf blades** are V-shaped in cross section when young, and smooth (glabrous). The ligules are longer than wide and V-shaped and 6-28 mm. The **inflorescences** are racemose, 6-40 cm long, and are composed of several ascending unisexual spikes, generally 2-6 lower pistillate spikes and 1 (or 2) terminal staminate spikes. The **bracts** are leafy and have a sheath 1-9 cm long with blades 20-70 cm x 4-11 mm. The **pistillate spikes** are separate from one another (the peduncles of the basal 2 are 1-13 cm long and 2-17 cm apart), densely 8-75 (-90)-flowered, cylindric, ascending, the uppermost more or less crowded, bur-like, and 2-8 cm x 1.5-3 cm; the **staminate spike** is 2-10 cm x 2-5 mm with a peduncle 1-12 cm long that is shorter than to somewhat exceeding the uppermost pistillate spike; there is rarely a second, shorter, staminate spike at the base of the terminal one. The **staminate scales** are 6-11 mm long, lanceolate to narrowly oblanceolate, tapered to a pointed or awned tip, and are straw-colored with a green midrib and white margins. The **pistillate scales** are 3-9-veined, lanceolate, 6-13 mm x 1.8-3.2 mm and are acute to awned, the awn is rough and up to 5.5 mm long, and they are straw-colored with a green midrib and white margins. There are 3 **anthers**, 3.5-7 mm long. The **perigynia** are relatively large, have 3 exposed stigmas, are mostly ascending to spreading and they are distinctly 17-25-veined, sessile, lance-ovoid (narrowly ovate in outline), inflated and not tight around the achene, green to yellowish-brown at maturity, 12-19 mm x 3.8-6 mm, dull to shiny, and glabrous; the bidentate beak is conic, 6-9 mm long, with teeth less than 1 mm long. The **fruit** is a broadly stipitate achene 3-4.5 mm x (2.2) 2.4-3.4 mm, longer than wide or sometimes about as long as wide, diamond-shaped, widest at the middle, with strongly concave faces, the angles are thickened and prominently knobbed with hard, nipple-like points; the style is strongly contorted near the base and the same hard texture as the achene. The

chromosome number is $2n = 60$ (Gleason and Cronquist 1991; Reznicek and Ball 1974). There has been speculation that the False Hop Sedge was derived through aneuploidy from *C. lupulina* (which has a chromosome number of $2n = 56$), and that this may help to explain its rarity (W-2) relative to that other species. The plants can be fertile from spring (April) to summer and can be found in fruit from July until September, and rarely later. (Adapted from Yatskievych 1999 and Reznicek 2002). This is one of the largest and conspicuous species of the genus *Carex*, and it shows little variation in size.

The False Hop Sedge is somewhat difficult to identify (Hill, pers. obs.; W-2), especially when immature, because mature fruits (both the perigynia and achenes inside) are needed along with a plant complete enough to confirm whether rhizomes are present or not. It is especially difficult to distinguish from the very similar, common, and closely related *Carex lupulina*. For this reason, a somewhat expanded identification guide is presented here. A **summary of the identification characters** diagnostic for *Carex lupuliformis* follows: 2 or more ascending to erect spikes per stem; stigmas 3, style becoming bony in texture; achenes trigonous [3-sided, not lens-shaped]; perigynium broadly ovoid, inflated, gradually beaked and with well developed and stiff apical teeth; perigynium not wing-margined; perigynia 12-20 mm long; well developed (long) rhizomes present; sheath of the uppermost non-bracteal leaf usually more than 1.5 cm long; perigynium beak 4.5-10 mm; mature achene about as wide as long or longer than wide and widest near the middle; the perigynia are usually ascending to slightly spreading, the staminate peduncle is shorter than or equaling the uppermost pistillate spike, the angles of the achene have a nipple-like point, the faces are strongly concave (features derived from the keys in Gleason and Cronquist 1991).

Among its relatives that are most likely to be confused with this species, *Carex grayi* and *Carex intumescens* (the least likely to be confused with it) have no rhizomes and they have a shorter perigynium beak (1.5-4.2 mm), whereas the remaining four species in the group have conspicuous rhizomes and a beak 4.5-10 mm long. *Carex louisianica* (which has rhizomes) has a staminate peduncle much surpassing the uppermost pistillate spike whereas in the remaining three this peduncle is shorter than to about as long as the uppermost pistillate spike. *Carex lupuliformis* has ascending perigynia that can sometimes be somewhat spreading and the achenes are longer than wide or as long as wide, widest at the middle, have deeply concave sides, and the angles on the achene are pointed into nipple-like knobs (see Yatskievych 1999 for illustration) and this last is the most reliable single feature used to distinguish the species; the very similar equally rhizomatous *Carex lupulina* also has ascending perigynia, achenes that are longer than wide or as long as wide and that are widest at the middle, but the pistillate spikes are narrower, the achene has nearly flat sides and the achene angles are narrowly rounded and neither pointed nor nipple-like. In the field, *Carex lupulina* appears stockier in form with narrower leaves than *C. lupuliformis* (Reznicek cited in W-2) and *C. lupulina* matures earlier and senesces earlier than *C. lupuliformis* (Thompson and Paris 2004). In contrast to the last two species, *Carex gigantea* has spreading perigynia and achenes that are wider than long and widest above the middle with strongly concave sides and the angles are thickened towards the middle. *Carex lupuliformis*

normally has perigynia that are persistent until frost, and its size averages between that of the smaller *C. lupulina* and the larger *C. gigantea*. The False Hop Sedge is a distinctive species only when complete plants with mature fruits are available, and immature or incomplete material may not be identifiable with certainty.

HABITAT AND ECOLOGY

The False Hop Sedge has been given a national wetland indicator status of FACW+, OBL, indicating that the species tends to grow in wetlands, but not all individuals do. In the northeastern and north-central parts of the country (Region 3, including Illinois and Indiana), this plant is classified as a FACW+ species, and in the southeast and south plains it is classified as an OBL species [OBL = Obligate wetland species that under natural conditions occur almost always (> 99% probability) in wetlands; FACW+ = Usually occur in wetlands (estimated probability 67%-99%), but occasionally found in non-wetlands] (Reed 1988; W-3). These habitats include forested wetlands (see White and Madany 1978), wet thickets, and most frequently in floodplain (bottomland) forests and around ponds in wet forest openings at elevations of 0 – 500 m. Reznicek and Ball (1974) stated that the habitat of *Carex lupuliformis* is more aquatic than for other members of its section, and that it grows in shallow waters of open marshes and on wet shores sometimes as an emergent aquatic. The species is typically found in river bottoms, frequently occurring in buttonbush (*Cephalanthus occidentalis*) swamps in water about 0.5 m deep, or in the backwaters of streams in heavy soils that are subject to severe flooding (Reznicek cited in W-2). In northern New England, most populations are found in lakeside floodplain forests, while in southern New England most populations occur in vernal pools (Thompson and Paris 2004).

When growing in forests this sedge is restricted to very wet floodplain forests that possess a moderately open canopy (Reznicek cited in W-2). The False Hop Sedge prefers openings or margins of forested wetlands – it is not at all common in deep shade. Individuals of the species tend to grow better as the canopy becomes more open, and this has been reported for nearly every known population throughout its range (W-2). The largest known populations of more than fifty plants in Delaware and several populations of 300-400 and up to 1000 individuals in Mississippi all occur in areas where openings have been artificially developed and maintained through logging and mowing, respectively (W-2).

Carex lupuliformis is often thought to be a calciphile (preferring a calcareous substrate), but there is little published data on this. Thompson and Paris (2004) provide some data indicating that Connecticut sites have a pH range from pH 4 to nearly neutral, and that the Vermont sites are all within the generally calcareous Champlain Valley. The river silts in which the sedge commonly grows are often rich in calcium. Plants are found in circumneutral sites in some portions of its range, such as in the northeastern states and Ohio (W-2). In some parts of the south, plants can appear to be chlorotic in areas that tend to be acidic, in contrast to *Carex lupulina,* which grows well at such sites (W-2). It would seem that the organic mucks of

Cephalanthus swamps and similar habitats where it has been found may tend to be acidic, but it appears that more data is needed to be certain. Many sites do appear to be in areas influenced by calcareous substrates in some way.

On herbarium labels, habitats listed included floodplain forests, marshes, Bald cypress-Tupelo gum swamps, ponded areas, moist or wet forests, forested fens, swamps, swampy lake shores, swales, wet meadows, and low roadside ditches. The soils where the plant grows have been described as sandy or silty clay loam. The organic substrate may be rich in plant nutrients. While the water in its habitat may be periodically stagnant, this species appears to require requires high-quality conditions without hydrologic alterations such as significant water level change or chemical pollutants (W-2).

While the False Hop Sedge does not generally grow in or next to deep water or on the bases of trees standing in water like *Carex decomposita* Muhl. (Hill 2006), it does appear to avoid dense shade. It often grows in more open wetlands and meadow-like areas such as lake margins where trees are somewhat separated from one another, as is typical in both hardwood and bald cypress swamps.

The most common **tree** associates in the Great Lakes region (including northern Illinois and northern Indiana) near its northern range limits are *Acer rubrum*, *Acer saccharinum*, and *Fraxinus pennsylvanica*, along with the very common **shrub** associate *Cephalanthus occidentalis*. Associated **forbs** include *Asclepias incarnata, Bidens cernua, Brasenia schreberi, Campanula aparinoides, Epilobium coloratum, Eupatorium maculatum, Eupatorium perfoliatum, Galium tinctorium, Iris shrevei, Lemna trisulca, Lobelia siphilitica, Lycopus americanus, Lysimachia thyrsiflora, Potentilla palustris, Ranunculus sceleratus, Sagittaria* spp., *Scutellaria epilobifolia, Scutellaria lateriflora*, and *Sparganium americanum*, and associated **graminoids** (sedges and grasses) can include the sedges *Carex hystericina, Carex stipata, Carex suberecta, Dulichium arundinaceum, Eleocharis obtusa, Eleocharis smallii*, and *Scirpus acutus*, and the grass *Glyceria striata* (Swink and Wilhelm 1994). Other northern sites (*e.g.*, New York, New Jersey, Vermont) have indicated several additional associates in calcareous habitats (such as limestone sinkhole ponds) including the **tree** *Salix* sp., the **forbs** *Boltonia asteroides*, *Butomus umbellatus*, *Impatiens* sp., *Lysimachia hybrida*, *Lythrum salicaria, Mentha arvensis, Ranunculus flabellaris*, and *Sagittaria cuneata*; **graminoids** (sedges and grasses) are frequent associates of this species, including the **sedges** *Carex lupulina*, *Carex retrorsa*, *Carex typhina*, *Carex viridula*, and *Cyperus aristatus*, and the **grasses** *Eragrostis hypnoides* and *Phalaris arundinacea*, and another associate is often the **fern** *Thelypteris palustris*.

In West Virginia, where *Carex lupuliformis* has been found in occasionally inundated and permanently saturated openings within emergent shrub marshes, the associates are commonly the **trees** *Acer rubrum*, *Alnus serrulata*, *Nyssa sylvatica*, and *Quercus palustris*, the **shrubs** *Cephalanthus occidentalis* and *Rosa palustris*, the **forbs** *Polygonum hydropiperoides*, *Sparganium americanum*, and *Sparganium eurycarpum*, and **graminoids** (sedges and grasses)

including the **sedges** *Carex bromoides, Carex grayi, Carex lupulina, Carex squarrosa, Carex stipata, Carex stricta, Carex tuckermanii, Carex typhina, Carex vesicaria*, and *Dulichium arundinaceum*, and the **grasses** *Leersia oryzoides* and *Panicum rigidulum.*

In the southern (Atlantic coast and Gulf coast) states, *Carex lupuliformis* often grows in open sunlight in rights-of-way, as well as in the more characteristic wet floodplain forests. It often occurs in seasonally to semi-permanently flooded back swamps, sloughs, and bottomlands of Coastal Plain rivers and streams, often in Bald Cypress – Tupelo Swamps (a natural community and a type of forested wetland; see W-4) where the habitats may be flooded up to 1.3 m deep for part of the year and which have either peaty organic swamp soils or mineral-rich silts. Associates here often include the **trees** *Acer rubrum, Fraxinus caroliniana, Liquidambar styraciflua, Nyssa aquatica, Nyssa biflora, Planera aquatica, Populus heterophylla, Quercus lyrata, Quercus nigra*, and *Taxodium distichum*, and the **shrubs** *Cephalanthus occidentalis, Clethra alnifolia, Sabal minor*, and *Sambucus canadensis*. **Vines** are usually sparse or absent in this habitat, but *Decumaria barbara* and *Smilax walteri* can be rather common locally. Associated **forbs** can include *Bidens discoidea, Boehmeria cylindrica, Boltonia caroliniana, Iris prismatica, Lindernia dubia, Ludwigia sphaerocarpa, Lycopus rubellus, Pluchea camphorata, Ranunculus* spp., *Saururus cernuus,* and *Triadenum walteri.* Associated **graminoids** (sedges, rushes and grasses) are common, including the **sedges** *Carex bullata, Carex crus-corvi, Carex frankii, Carex hyalinolepis, Carex joorii, Carex lupulina, Carex seorsa*, and *Carex tribuloides*, various **rushes** in the genus *Juncus*, and the **grasses** *Erianthus strictus, Leersia lenticularis, Panicum rigidulum*, and *Paspalum fluitans.*

In eastern Texas at the southwestern margin of its range, most of the same species from the southern Coastal Plain occur with the False Hop Sedge, and herbarium labels on Texas specimens have also indicated the occasional presence of the **trees** *Liquidambar styraciflua, Nyssa* spp., *Pinus* spp., *Planera aquatica, Quercus* spp., *Salix* sp., *Sapium sebiferum*, the **shrub** *Sabal minor*, the **vine** *Vitis* spp., the **forbs** *Gratiola* sp., *Hypericum* spp., *Justicia americana, Polygonum* spp., and *Saururus cernuus*, as well as **graminoids** (sedges, rushes and grasses) including the **sedges** *Carex* spp., *Eleocharis* sp., the **rush** genus *Juncus*, and the **grasses** *Erianthus strictus, Panicum* sp., and *Spartina.*

In the Midwest, *e.g.* Missouri, Illinois, and Indiana, the False Hop Sedge continues to be found in swamps, lake margins, and sinkholes generally associated with many of the same wetland species, but with a great variation depending on latitude. Northern associates include those listed for the Great Lakes region, above. Additional associates from both northern and southern sites within these states include the **trees** *Acer rubrum, Fraxinus profunda, Nyssa aquatica, Populus heterophylla, Quercus bicolor, Quercus palustris*, and *Taxodium distichum* and the **shrubs** *Cephalanthus occidentalis, Cornus* spp. *Salix nigra*, and *Styrax americana.* **Vines** are usually sparse or absent in this habitat. **Herbs (forbs)** may include *Armoracia aquatica, Aster lateriflorus, Bidens aristosa, Bidens discoidea, Boltonia asteroides, Epilobium leptophyllum, Helenium autumnale, Hibiscus* spp., *Physostegia* sp., *Polygonum amphibium, Typha* spp., and

additional seasonal aquatic species. Other **graminoids** are usually common, including the associated **sedges** *Calamagrostis canadensis*, *Carex crus-corvi, Carex lupulina*, *Carex squarrosa*, *Carex tribuloides*, *Carex vulpinoidea*, and *Rhynchospora corniculata*, and the **grasses** *Alopecurus aequalis*, *Glyceria* spp., *Leersia* spp., and *Phalaris arundinacea*. In Illinois, the False Hop Sedge is said to be not common but scattered throughout the state in wet ground in wet woods, wooded swamps, marshes, meadows, and roadside ditches (Mohlenbrock 1986, 2002).

DISTRIBUTION AND ABUNDANCE

Carex lupuliformis, the False Hop Sedge, is a widespread species known in eastern North America, from Texas to Florida and north to Maine and (possibly) Minnesota as well as a limited area in adjacent Ontario and Quebec, Canada. Its historic range within the United States is somewhat debatable because many specimens of this species have been misidentified as other similar species, especially as those of the more common *Carex lupulina*, which overlaps in range and may occur along with it at many sites (W-2). In the United States the most recent treatment (Reznicek 2002) indicates that this sedge is known to occur in twenty-six states, namely, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Texas, Vermont, Virginia, West Virginia, and Wisconsin. There is not a general agreement on this distribution, however. The Nature Conservancy at its website (W-2) excludes Georgia, and includes Kentucky, Maine, Minnesota, and Tennessee within its range, though in apparent contradiction on a subsequent page on the same site it argues that the species does not actually occur in Minnesota (W-2). The U.S.D.A. at its website (W-1) excludes Massachusetts and Oklahoma, and includes Alabama, Kentucky, Maine, Minnesota, and Tennessee within its range. Therefore, based on these three primary references, the minimum number of states in which it has been found is twenty-three (26 – 3), and the maximum is thirty-one (26 + 5; Reznicek 2002; W-1, W-2). The discrepancy is probably a result of misidentifications of specimens, as well as a result of questions concerning the validity of the species. Its range includes both glaciated and unglaciated areas. As with most other species, it becomes scarce at the margins of its range. Its historic range was significantly larger than its current range assessed on a county basis, and its decline appears to have been accelerating in recent decades because of the loss of habitat (W-2). According to Reznicek (cited in W-2) *Carex lupuliformis* is not common in any portion of its range.

Based upon its state rankings (W-2), this sedge occurs most frequently in Kentucky (though Reznicek [2002] indicates it is not in that state) where it is ranked S4S5, followed by Mississippi where it is ranked as an S4 species. This is followed by Illinois where it is ranked as an S3 species. It appears to have been lost in Iowa where only historic reports (SH) are known (W-2). It is in danger of disappearing in eighteen of the remaining twenty-five states. It is not ranked in seven states (W-2). The species is thought to be primarily a Coastal Plain species, with a secondary center of distribution in the Mississippi alluvial plain north to the Great Lakes region

(Reznicek 2002; W-1, W-2). This sedge species is local within most of its range because of its habitat preferences.

The current distribution of the False Hop Sedge (ignoring for the moment the controversies regarding identification) includes all but one of the same states as its historic distribution (it is classified as historic only in Iowa), but within several states its county distribution has generally declined. In Connecticut, for example, there are no known extant sites for this sedge (W-2) though Thompson and Paris (2004) refute this. Additional details on the distribution of this sedge can be found in Kartesz and Meacham (1999), Radford *et al.* (1964), and Yatskievych (1999) and several Internet sites (*e.g.*, W-1, W-2). Representative specimens of this sedge have been listed in Appendix 1. A summary of the distribution of the False Hop Sedge has been presented in Appendix 2.

Within the U.S. Forest Service Eastern Region (Region 9), *Carex lupuliformis* has been reported in two national forests (W-5), namely, the Shawnee National Forest (IL) and the Finger Lakes National Forest (NY). It has not been found within the Hoosier National Forest (IN) though it is within the state and it may occur within this forest. The sedge is known to occur within several national forests in the Southern Region (Region 8).

In Indiana, where it is listed as state rare, *Carex lupuliformis* has been found in widely scattered locations in forested swamps from north to south, and it is known historically from at least fourteen counties (see Appendix 2; W-1; W-2; Homoya, pers. comm.; Deam 1940).

In Illinois *Carex lupuliformis* is not threatened or endangered and it is not tracked, though it is considered to be vulnerable (ranked S3; W-2). As in other states, many of the records are thought to have resulted from misidentifications of *Carex gigantea* and *Carex lupulina*, among others, and so it is not as common in the state as previously thought. The species has been reported historically in 38 to 46 counties (depending on the source; see Appendix 2). Only a critical examination of all known specimens could verify the actual range of the species in Illinois (as well as in the other states). The Illinois Natural History Survey Herbarium (ILLS) in Champaign, which has the largest collection of Illinois plants, contains only nineteen Illinois specimens identified as this species, and these are from sixteen different counties. If the historic distribution records are correct, this sedge has been found in essentially every Illinois Natural Division (Schwegman et al. 1973). In southern Illinois it has been reported from Alexander, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, and Union counties.

Within the Shawnee National Forest in southern Illinois, *Carex lupuliformis* has been found at the LaRue-Pine Hills/Otter Pond Research Natural Area (Mohlenbrock 1959; Shawnee National Forest 2005) and probably occurs elsewhere, but it has not been sighted or collected within the forest for several years (the most recent collection seen from the Shawnee National Forest was made in 1966). However, because it is not tracked by the state, and because it is not generally sought out in Illinois, one cannot draw many conclusions as to its current distribution and

frequency here.

Despite the lack of recent data, it is generally thought that the populations of this sedge in Illinois and other parts of the Midwest are scattered as is typical for *Carex lupuliformis* throughout its range. Because of the specific habitat preferences of this sedge, the populations are isolated from one another. It is likely that the species was somewhat more common in the region at the time of European settlement because it is well known that the acreage of swamps and similar wetlands has declined considerably in the past 200 years.

Carex lupuliformis is not a weedy species but it can form large colonies and so appear locally frequent. There is no specific data in the Illinois Heritage database regarding population sizes because it is not tracked, and none of the Illinois herbarium labels viewed had information describing frequency or population sizes. Information from outside of the state, including label data, indicates that the plant can be locally frequent or abundant rather than locally scarce, even at the margins of its range. Because of the plant's ability to form very large colonies by means of its rhizome systems, a single plant may go on to establish a large colony in time, either by seeds or rhizome growth or both. However, the number of genetically different individuals in a colony is not known because all stems could be interconnected by means of the long rhizomes typical of this species.

Some contradictory information was also presented on the Nature Conservancy's website (W-2). One entry stated that the population sizes of *Carex lupuliformis* are generally described as small, averaging "roughly 15 individuals. In some areas, though, populations may be substantially larger. Very little is known about the life history of this species." Thompson and Paris (2004) indicate that in New England many of the populations are quite small, usually 1-10 culms, with only five of the reported 47 populations having more than 100 culms.

In summary, the only facts concerning the distribution and abundance of *Carex lupuliformis* that appear to be generally accepted are that the species is distinct from similar sedges, that it occurs in at least 23 states and two Canadian provinces, that it is uncommon and scattered overall, that it grows in or near open, yet forested wetlands, and it can appear to be frequent locally at a specific site because it can spread by means of rhizomes.

PROTECTION STATUS

The Global status (ranking) for *Carex lupuliformis* is either G4 or G3G4 (W-2, W-6, Appendix 3) and this has led to some confusion. In the United States the species is given the National Heritage status rank of N4 or N3N4 with a similar meaning, and with a similar confusion. The conservation status for this sedge in Canada is N2. The state rankings vary tremendously, but it has been designated as Critically imperiled (S1) in Maryland, Massachusetts, New Jersey, North Carolina, Pennsylvania, Texas, and Wisconsin, Critically imperiled to imperiled (S1S2) in Arkansas, Imperiled (S2) in Delaware, Indiana, Michigan, New York, Ohio, Vermont, Virginia,

and West Virginia, Imperiled to vulnerable (S2S3) in Connecticut and Tennessee, Vulnerable (S3) in Illinois, Apparently secure (S4) in Mississippi, and Apparently secure to secure (S4S5) in Kentucky. It has been ranked as Historic only (SH) in Iowa. It has not been ranked in the other states where it occurs. *Carex lupuliformis* has been listed as Endangered in Connecticut, Massachusetts, New Jersey, and Wisconsin and Threatened in Michigan and Ohio. This sedge has been designated as either Rare or of Special Concern in Indiana, Iowa, and New York. As a S1S2 species in Arkansas, *Carex lupuliformis* is tracked in Arkansas and is included on the list of State Species of Special Concern – Plants (Arkansas Natural Heritage Commission 2005).

It appears somewhat contradictory for this species to be ranked as G4, apparently secure, while on the same official site (W-2) this statement appears: "This sedge is considered rare throughout much of its range, especially northward." Furthermore, on the same site (W-2) the global rank is later said to be G3G4, signifying that there exists some uncertainty over whether the species is globally threatened or is apparently secure. Because of this confusion some states are not tracking this species, others may not be ranking it because not all botanists believe that it is a distinct species (see Nomenclature and Taxonomy, above).

Carex lupuliformis is not tracked or protected in either Illinois or Missouri, and it has not been included on state sensitive plant lists for those states.

Carex lupuliformis has been designated as being at risk and has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) within the two National Forests where it is known to occur (W-5), namely, the Shawnee National Forest (IL) and the Finger Lakes National Forest (NY). It has not been included on the RFSS list for the Hoosier National Forest where it has not yet been found.

Protection for this sedge is currently dependent primarily on habitat protection, and so its survival will probably depend more on this than on species protection. *Carex lupuliformis* appears to be found generally in and around wetlands, many of which have a degree of federal or state protection.

Table 1 lists the official state rank assigned by each state's Natural Heritage program according to the Nature Conservancy at the NatureServe site (W-2). Appendix 3 explains the meanings of the acronyms used (W-6).

A summary of the current official protection status for the False Hop sedge follows:

U.S. Fish and Wildlife Service:	Not listed (None).
U.S. Forest Service:	Region 9, at Risk (Illinois, Shawnee National Forest; New York, Finger Lakes National Forest).

Global Heritage Status Rank: G4 [or G3G4]

U.S. National Heritage Status Rank: N4 [or N3N4]

Canada National Heritage Status Rank: N2

Table 1: S-ranks for *Carex lupuliformis* [Heritage identifier: PMCYP037T0; W-2]

State/Province	Heritage S-rank*
UNITED STATES	
Alabama	[may occur? – not in W-2]
Arkansas	S1S2
Connecticut	S2S3 [Endangered; Special Concern]
Delaware	S2
Florida	SU
Georgia	SNR [or S1S2]
Illinois	S3
Indiana	S2 [Rare]
Iowa	SH [Special Concern]
Kentucky	S4S5
Louisiana	SNR
Maine	SNR
Maryland	S1?
Massachusetts	S1 [Endangered]
Michigan	S2 [Threatened]
Minnesota	SNR
Mississippi	S4
Missouri	SNR
New Jersey	S1 [Endangered]
New York	S2 [Rare]
North Carolina	S1
Ohio	S2 [Threatened]
Oklahoma	SNR
Pennsylvania	S1
South Carolina	SNR
Tennessee	S2S3
Texas	S1
Vermont	S2
Virginia	S2
West Virginia	S2
Wisconsin	S1 [Endangered]
CANADA	
Ontario	S1
Quebec	S1

LIFE HISTORY

Carex lupuliformis, the False Hop Sedge, is a long-lived perennial sedge that appears to be capable of reproducing both vegetatively and by seed. It flowers and fruits regularly, and, as far as is known, the seeds have no viability problems. It also has the potential to reproduce vegetatively to form additional colonies by breakage of the long rhizomes that can attach many stems together, and so an individual may be very long-lived. It is known to be able to survive for many years at a given site (W-2). According to the Nature Conservancy, very little is known about the life history of this species (W-2).

The False Hop Sedge is a warm-season sedge, producing most of its growth in the summer

months. This sedge flowers regularly and, apparently, produces new individuals from seeds, which are normally mature and fall in late-summer to early autumn. As is typical in most members of the sedge family, pollen is dispersed by the wind and large quantities must be produced because of the ineffective nature of this pollination strategy. Herbarium records indicate that the plant can be found in flower as early as May 4 in the south and as late as June 26 in the north, depending on latitude and local conditions, but peak flower tends to be about late May to early June. The fruits appear to ripen slowly, and mature fruits have been recorded from about 10 July at the southern extreme of its range with a few fruits left on the plants as late as 28 October in the north (perhaps even as late as December according to Thompson and Paris [2004]). The usual peak fruiting period is about 4 August to 16 September. The perigynia of *Carex lupuliformis* are normally persistent until the first frost in contrast to those of *Carex gigantea,* which are non-persistent and have normally all fallen by the time of first frost (Reznicek and Ball 1974).

Carex lupuliformis occasionally is parasitized by a parasitic fly that develops through its larval and pupal stages within the achenes of this and three other closely related species (*C. gigantea, C. louisianica*, and *C. lupulina*; Reznicek and Ball 1974; W-2). The achenes can become distorted as a result of this parasitism and the perigynia themselves can turn straw yellow. The parasite is naturally occurring, and has not been implicated in the loss of any populations of this sedge, but it is an example of an interesting aspect in the life history of this sedge. It has led to the misidentification of specimens, and it is possible that reported hybrids actually might have been plants with deformed perigynia (W-2; Thompson and Paris 2004)

The 'seeds' (actually single seeded fruits called achenes) have thickenings towards their edges that may allow them to float in water, but the inflated perigynia themselves may eventually detach from the inflorescence axis and float. They generally will lodge on or near woody debris or in nearly any substrate at the high water mark, or on lower level sites as water levels recede in the summer and fall. After germination, the plants apparently establish roots and a rhizome quickly and they may grow into rather large colonies in time and live many years to continue the cycle. Unusually high water levels may damage the plants by drowning, and long-term desiccation of the substrate may damage or kill the plants by excessive drying, but herbarium records indicate that the plants are often found at the margins of seasonably inundated pools on exposed, elevated soils as well as in wet sand and muck. It appears that the plants need a seasonal inundation or wet period as well as a seasonal exposure, and they are not as fragile as the more site-specific species such as *Carex decomposita* (Hill 2006). Its limited number of occurrences at its northern range limits nationally suggests that this sedge is sensitive to either severe cold temperatures or to a limited growing season, but not to freezing. Its scarcity overall may also be due to competition from other plants and unusual changes in water level as well as to the general loss of its preferred wetlands.

Another means of dispersal for this sedge other than limited water transport may be as undigested seeds in the gut of waterfowl because the fruits have a rather tough achene wall.

According to Thompson and Paris (2004) the seeds appear to require light to germinate, and this may involve some disturbance to the soil. The seeds may be long-lived and may be common in the seed bank, sometimes growing into seedlings after periods when few or no seeds have been produced. Other observations suggest that the small populations may appear and disappear over time, and this is important to note when conducting surveys for this species.

POPULATION BIOLOGY AND VIABILITY

Carex lupuliformis regularly flowers and fruits throughout its range and it has no known reproductive problems. However, the sedge grows in widely scattered and often isolated wetlands over the landscape and there is very little interaction (pollen dispersal or seed exchange) with other populations of the same species. In addition, this is not an invasive species, and, as far as is known, few new populations have been found or have become newly established in recent decades. Again, however, problems in identification make nearly all data of this sort speculative.

It is generally understood by botanists that fertility is normally reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. In its preferred wetland habitats initial success is very important for this sedge. It is likely that new populations begin by means of a few seeds regurgitated or defecated by waterfowl that fly between wetlands. The widespread distribution can also be explained by this dispersal method. Therefore, if pollination should occur, self-fertilization is the most likely outcome because there is almost no chance of fertilization by other genotypes unless they are within dispersal range. It has been shown in the summaries above that most existing populations of this sedge are very isolated from one another and from the larger populations in the floodplains of the southern coastal plain. In theory, continued self-fertilization can result in severe reproductive problems in these isolated populations, and successful seed production as well as the genetic variation that allows competition with other species may be compromised (W-7).

An example of negative effects thought to have arisen through isolation of populations can be seen in the case of another graminoid, Ofer Hollow Reedgrass (*Calamagrostis porteri* ssp. *insperata* (Swallen) C.W.Greene), which has become isolated on rather dry sandstone bluffs rather than in isolated swamps. This grass almost never produces viable seed anywhere in its range and this reproductive failure may be a reflection of a high genetic load that has occurred as a result of its long isolation (see Hill 2003). High genetic load can be seen in dominant mutations that result in factors lethal to embryos, and this situation appeared to be indicated in that grass. That plant survives as a rare relict in the vegetative state only. This is most likely not the case with the False Hop Sedge, which is known to produce large numbers of seeds (theoretically as many as 540 per stem, but averaging less). However, there is no data at this

time on the fertility of the seeds produced. While it is a vulnerable species in the mid-west, the False Hop Sedge does appear to be secure in areas with suitable habitat remaining. Whether it persists or not in the future in areas where it is currently scarce appears to depend on the survival of its habitat.

POTENTIAL THREATS

Globally, the False Hop Sedge is considered to be either somewhat vulnerable to apparently secure (see Protection Status above). However, it has disappeared from at least one state where it has been found historically. It has declined significantly in several additional states and it is now threatened with extirpation in at least eighteen states (W-2). The reason for this decline has been the wholesale destruction of wetlands by draining for agriculture and housing developments (W-2). According to Reznicek (cited in W-2), the major threats to this species throughout its range include the damming of rivers, the drainage of river backwaters through ditching or channelization, floodplain cultivation, and the interference of the spring flood cycle. Other threats to the species are known to be the logging of the bottomland forests where they most frequently live.

Throughout its range populations have been eliminated by human activities. As discussed above, the False Hop Sedge grows in forested swamps or seasonally inundated wetlands with an open canopy, normally in wet sand or muck in seasonally shallow water. Because of this, it is not only sensitive to the loss of the wetlands themselves, but also to disturbances within the wetlands. The number one threat to the species continues to be the destruction and loss of wetlands to agriculture and development. The rapid urbanization of the level coastal regions and related draining of its wetlands is rapidly eliminating the species. Along with habitat destruction, water quality degradation from sewage pollution, manufacturing pollution, and agricultural pollution has taken its toll. In addition, changes in the quantity and force of water run-off resulting from dredging have caused increased rapid flooding and strong currents in normally calm floodplain swamps, resulting in devastating effects on *Carex lupuliformis* populations over time. The plant has become restricted to more and more isolated areas where relatively undisturbed isolated wetlands may still occur.

While *Carex lupuliformis* appears to do well in areas where the canopy is more open, including areas that have been recently logged, this increased population size is short-lived. Logged over forests tend to become a thick stand of shrubs and small trees in a few years after logging or clear cutting (W-2), and this greatly restricts the establishment and survival of this and other understory species that need an open habitat. The logging process, then, can destroy the habitat in which the pre-logging population flourished (W-2). The habitat would be again suitable for the sedge only after many years as the forest matures.

Exotic pest plants and invasive natives may be a threat to this species in habitats that have

become disturbed (W-2). At drier, especially southern sites, *Lonicera japonica* (Japanese honeysuckle) may be a problem, and at moderately moist northern sites *Lythrum salicaria* (purple loosestrife) can become a serious problem. Other well-known species that can crowd out the less competitive native plants at wet to moist sites are Reed canarygrass (*Phalaris arundinacea*), Common reed (*Phragmites australis*), and Narrow-leaf cattail (*Typha angustifolia*), though the first and third are less of a problem in southern areas.

In Mississippi, and perhaps elsewhere, populations of the False Hop Sedge often occur in railroad and highway rights-of-way and so are exposed to broadleaf herbicide application and mowing (Bryson, cited in W-2). Sedges are monocots and are generally not damaged by broadleaf herbicides but they are vulnerable to damage from more generalized herbicides. As in the case of *Carex decomposita* (Hill 2006) *Carex lupuliformis* may have been eliminated in areas adjacent to rice fields where herbicide (2-4-D or 2-4-5-T) has been used. Mowing may not result in permanent damage, though it may eliminate seeding spikes during a given season.

The frequent physical disturbance and / or construction, such as highway construction, can also result in significant damage to local populations. Some populations have been imperiled by all-terrain recreational vehicles (W-2).

The conversion of natural ponds and wetlands to livestock ponds through the deepening and removal of the native plants has been a significant threat to this and other wetland species (W-2). Otherwise natural ponds may be seriously degraded by livestock grazing and wallowing in them during periods of prolonged drought or because of over-stocking as well.

As stated in the previous section on Population Biology and Viability, it is generally believed among biologists that habitat fragmentation can also have profound effects on the success and persistence of local populations through a process known as inbreeding depression in small populations. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois populations of this plant, random genetic drift may have already occurred and this may have caused negative effects to the species. This genetic drift may cause the individuals to be less adaptive to competition and environmental change.

At the current time, it appears that the status of populations of *Carex lupuliformis* in the Shawnee National Forest are unknown, but, based on records of other sensitive wetland species, that are probably comparatively safe, provided that habitat change and disturbance can be prevented. It appears that the species is more common elsewhere in the state, and, while vulnerable, it is unlikely to become endangered in the near future.

RESEARCH AND MONITORING

The False Hop Sedge has been the subject of some research and monitoring as have other species thought to be vulnerable or imperiled throughout their ranges. The primary conclusion reached is that periodic monitoring is needed to determine the threats to habitat caused by water fluctuations, habitat drainage, exotic species, and land development wherever this species occurs. Population stability, reproduction, and vigor should all be monitored. Research needs include continued and additional searches for additional populations to re-evaluate the plant's status. Little basic information is known concerning the life history of the plant, and specific details are not known on its fertility, dispersal mechanisms, germination and establishment requirements, growth rates, and genetic health (including variability). While water level fluctuation has been observed commonly in its habitat, it is not known precisely how much fluctuation can occur without adversely affecting the plants. It is also not known how well this sedge can be established in newly created forested wetlands, though it is thought that it could be introduced to former sites as well as mitigation sites if necessary.

Previous research on this and other floodplain species has shown that the conditions within entire watersheds where the sedge grows must be taken into consideration (W-2). However, it is not known exactly how much disturbance can occur before an individual population is adversely affected, nor is it known how large a wetland is needed to support a viable population. Monitoring of the water levels and water quality of a given site can assist in determining the health of each population once it is known exactly what the water levels and qualities should be for optimal health, and this may modify the need for frequent surveys of the plants themselves once initial population data has been gathered.

Population data for this sedge is made more difficult by the fact that it is difficult to determine how many distinct plants actually occur at a given site. More information is needed on how many genetically distinct individuals may actually occur at a given site, and little is known on the seed fertility of the plant as well as on seedling establishment and success. It is thought that many or most stems, or genets, at a given site may all belong to a single individual plant and that they may be genetically identical. Only sophisticated laboratory techniques can prove or disprove this hypothesis.

It is known that individuals of the species tend to grow better as the canopy becomes more open, and this has been reported for nearly every known population throughout its range (W-2). The largest known populations of the species all occur in areas where openings have been artificially developed and maintained through logging and mowing, respectively (W-2). It is not known if specific research projects have supplied hard data on these effects, and further study is needed.

Periodic surveys are needed to determine the health and productivity of the population by counting the numbers of individuals. This is the only means to determine population trends accurately (W-2). Reproductive success can be estimated by counting the number of fruiting

stems produced each season because seedlings and young plants cannot easily be identified in the field. As part of the basic research on current populations of this species, data such as the counts of numbers of individuals present, the determination of the amount of yearly flowering and seed production that might occur, and an assessment of recruitment rates are greatly needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over time at each site. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known. Some populations of *Carex lupuliformis* are being monitored currently by botanists working on behalf of the state Natural Heritage programs and other organizations in the areas where it is listed as endangered or threatened (see Thompson and Paris 2004).

Carex lupuliformis is so poorly understood and generally difficult to locate that a primary emphasis should be to locate and vigorously protect all remaining populations. Similar habitat should be explored for the plant and they can be checked occasionally for newly established populations (possibly distributed by flooding or waterfowl). Because wetland mapping has been given such a high priority through the U.S. Fish and Wildlife Service's National Wetlands Inventory (W-3) potential habitats should be relatively easy to find and monitor at the proper season, and habitat losses can also be recorded. There are small to moderate areas of additional suitable habitat in southern Illinois where the sedge could also exist, and these sites could also be suitable for several other imperiled wetland species (*e.g.*, searches could be conducted simultaneously for *Carex decomposita, Carex gigantea*, and *Carex lupuliformis*). A list of associates and indicator species has been compiled as a result of field studies in Illinois and other states (see Habitat section above). These indicator plants can be very useful in facilitating the discovery of additional populations of this sedge. Mature fruiting material is normally needed for positive identification of this sedge, and so particular attention should be made to search and / or monitor this sedge at its peak period for fruiting in one's local area, normally in August or early September. One should also be prepared to check for the presence of rhizomes on the plants to further minimize misidentifications, and a small tough hand trowel may be best for this procedure. Because of the general difficulties in identifying this sedge, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. It is quite possible that populations have been overlooked because of the difficulties in field identification for this species as well as because of the lack of adequate voucher material.

Botanical surveys conducted by scientists from the Illinois Natural History Survey and elsewhere have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered occasionally can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists and students in cooperation

with Illinois Department of Natural Resources personnel. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

RESTORATION

There are no known restoration efforts being conducted on *Carex lupuliformis* anywhere in its range, but the restoration potential of this and similar species may be good. Fruit production in this species appears to be dependable. However, the species, while widely distributed, is rare throughout its range. Consequently, it is somewhat doubtful that numbers of occurrences or individuals will rise to such a level as to eliminate the need for tracking and protection (W-2).

In order to restore this species to areas where it historically occurred, it is generally thought that the habitat itself must be restored (W-2); this is the generally recommended method to manage populations of this and other rare plants, to protect and manage their habitat. Protection of the hydrology is crucial, and natural flooding regimes are to be allowed. This must take into account the features of the entire watershed within which the sedge's habitat occurs. Management must not only protect the immediate habitat but also protect the upstream areas within the watershed that may affect flooding regimes or that may carry in pollutants. This would include management of upland forests to avoid serious flooding events as well as the elimination of channelization or dredged streams. It is important to obtain and include a buffer area in order to protect the False Hop Sedge populations from herbicide drift or other pollution factors as well as from logging operations.

Initial controlled clearing of timber within its habitat may result in a population increase for this sedge, as has been documented (W-2). This assumes that there is a healthy population already present with a healthy seed source. However, if selective thinning or cutting is to be used as a management tool, one must realize that the subsequent increased growth in saplings and shrubs must also be controlled to prevent the sedge from being crowded out by shade. This sort of population explosion is dependent on a good seed source being present within the habitat to allow a successful initial establishment. This is possible in certain areas in Mississippi, and possibly Kentucky, but most other populations are small and there may be insufficient fruit production to allow this rapid colonization. On the contrary, without careful study to determine how many trees can be safely removed, the entire population of the sedge could collapse some time after indiscriminant cutting. There is some evidence that managed clearings are beneficial to this plant (W-2) and so some mowing and selective herbicide application (avoiding broad-spectrum herbicides) may eventually be necessary for the continuation of the species. This would be a useful area of research to determine the proper management needed, and another similar management tool may involve fire management (Shawnee National Forest 2005). This sedge is relatively well protected from fire because of its underground rhizomes, and some fire

management may benefit this species through the elimination or suppression of shrubs, exotic herbs, and saplings (W-2).

In populations growing in upland areas that occur along railroad, highway, or powerline rights-of-way, active eradication of woody competition through mowing, manual cutting, or broadleaf herbicide treatment has been suggested to maintain this sedge (W-2). Treatment for other exotic species in both upland and low habitats may be needed as well, and this would include management for the exotic broadleaf species *Lonicera japonica* and *Lythrum salicaria* as well as for the locally invasive monocot *Butomus umbellatus* (in northern calcareous wetland site), for which a specific herbicide is unavailable. Eradication of cattail (*Typha*) and invasive grasses such as *Phalaris* and *Phragmites* pose a far more difficult problem for this sedge because most if not all known herbicides that are effective against these species will also affect the sedge.

It is generally recommended that the habitat quality where this plant grows should be monitored on a regular basis and an assessment of the specific threats to all populations should be made (W-2). As discussed in the previous section, successful management or restoration of the False Hop Sedge depends on periodic surveys of both the environment in which they grow as well as the monitoring of population sizes and individual plants. Nearby land use should be noted – as in the case of the conversion of areas to tree plantations and rice farming and its chemical and hydrologic effects on adjacent vegetation. While many herbicides are obviously detrimental, so are fertilizers, which can cause an increase in this habitat of such common native competitive herbs as *Bidens, Boehmeria,* and *Pilea* as well as the grasses, exotic forbs, and cattails already mentioned, crowding out the *Carex* and other comparatively slow growing natives.

Wetland mitigation, or the creation of new wetlands to mitigate for those lost through land development, has become an important tool used in the restoration of wetland habitats (W-8; W-9). Actual restorations of any native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions or the result could be the success of a plant or plants that cannot be considered truly native (considered by some to be a plant community reconstruction rather than a restoration). Local plants should be propagated for planting in such an effort. Sedges are normally easily propagated by means of seeds and / or rhizome cuttings under controlled conditions.

It is not known what the minimum population size should be for the viability of this species, or for many other species (Thompson and Paris 2004). Several sources have useful information that may be of assistance in this area (Given 1994, Menges 1991, Shaffer 1987).

At this time, there is no known commercial source for seeds or plants of this scarce sedge.

In summary, the management for extant verified colonies of *Carex lupuliformis* should include

the maintenance of current hydrology within its habitat, the protection of its habitats from logging without a specific long-term management plan, land development, indiscriminate or nearby herbicide or fertilizer application, and from the establishment of invasive species. At this time, with proper management, current populations should persist but the establishment of additional populations will be, most likely, only through active human efforts.

SUMMARY

The False Hop Sedge is a robust, tufted, rhizomatous sedge that grows up to 130 cm tall. There is only the typical widespread variety and it was found historically in from twenty-three to thirty-one states and in two Canadian provinces, from Maine to Minnesota south to Texas and Florida, and in limited adjacent portions of Quebec and Ontario, Canada. It can appear to have many stems at a single site but it is not common anywhere in its range. It grows mainly in at least seasonally inundated swamp forests. It reproduces normally by seed but it can also propagate by means of its extensive rhizome system. One of the greatest difficulties in working with this plant is the frequency of misidentification of specimens, and this has resulted in some confusion as to the exact range and status of the species. Globally, its ranking is G4 or G3G4, indicating some uncertainty as to whether the species is globally threatened or apparently secure. *Carex lupuliformis* has been listed as Endangered in Connecticut, Massachusetts, New Jersey, and Wisconsin and as Threatened in Michigan and Ohio. This sedge has been designated as either Rare or of Special Concern in Indiana, Iowa, and New York. As a S1S2 species in Arkansas, *Carex lupuliformis* is tracked and included on the list of State Species of Special Concern – Plants. This sedge is considered to be vulnerable in Illinois, but it is not listed here as threatened or endangered nor is it tracked in the state. *Carex lupuliformis* has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) in the Shawnee National Forest (IL) and the Finger Lakes National Forest (NY). It has not been included on the RFSS list for the Hoosier National Forest, where it has not been found. It is considered at risk in these forests because of its generally sensitive state ranking and because of its scarcity in the Midwest. It is known from several southern national forests as well.

Positive identification is very important in evaluating the status and potential survival of this sedge because many former records have been based on misidentified specimens. Surveys should be conducted in summer when the individuals have mature fruit, and an examination of the plant's rhizomes may also be necessary. Voucher specimens are considered to be very important to verify the correct identification of this sedge.

Suggested research priorities for this rare sedge include attempts to locate additional populations and to gather more basic data on its life history, including fertility, establishment, and population dynamics. More information is needed on how many genetically distinct individuals may actually occur at a given site, and little specific information is known on its habitat requirements. Maintenance of each site's hydrology, including the flooding regime and water quality, and the

maintenance of an open canopy appear to be crucial to the existence of this species. Management through both the restoration of its historic wetland habitat as well as through the enforced protection of its existing habitat appears to be necessary to allow this sedge to persist where it may still occur.

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APPENDIX 1

Representative United States specimens of *Carex lupuliformis* examined or cited in the literature

Herbaria:

CHSC = Chico state University, Chico, California. ILLS = Illinois Natural History Survey, Champaign. MICH = University of Michigan, Ann Arbor. MISS = University of Mississippi, University. MO = Missouri Botanical Garden, St. Louis. UNA = University of Alabama, Tuscaloosa.

ARKANSAS: ARKANSAS CO., 5.8 mi NE of White River on AR Rt. 1, 8 Jun 1995, *Hyatt 6630* (UNA); **BRADLEY CO.**, La Bum Creek, Ingalls, 9 May 1972, *Demaree 64772* (MO); **FAULKNER CO.**, Hamlet, P.O. Vibonia, 7 May 1972, *Demaree 64812* (MO); **LEE [?] CO.**, St. Francis River, Rattlesnake Island, 20 Aug 1897, *Trelease s.n.* (MO).

DELAWARE: NEW CASTLE CO., Wilmington, s.d., *Canby s.n.* (MO); Townsend, 11 Jul 1877, *Chickering, Jr. s.n.* (MO).

FLORIDA: MADISON CO., 5.8 mi NE on FL Rt. 14 from jct. With US Rt. 221, 30 May 1990, *Jones & Jones 5111* (MO); **SUWANNEE CO.**, W side Live Oak, 4 May 1976, *Kral 57862* (MO); **TAYLOR CO.**, 25 mi E on US Rt. 98 from FL Rt. 59-N, W of Hampton Springs, 10 Jul 1991, *Jones & Wipff 7308* (MO).

ILLINOIS: ALEXANDER CO., E of Miller City, 20 Jun 1951, *Evers 30438* (ILLS); **COOK CO.**, Glen Ellyn, 4 Aug 1897, *Umbach s.n.* (MO); Skokie Marsh, Glencoe, 12 Jun 1911, *Sherff s.n.* (MO); **FULTON CO.**, Hoxie Ridge, E of Banner, 16 Jul 1963, *Chase 17480* (ILLS); **HANCOCK CO.**, S of Warsaw, 9 Jul 1949, *Evers 18318* (ILLS); **HENRY CO.**, N side Rt. 92 1 mi E of Rt. 82, 22 Jun 1936, *Dobbs s.n.* (ILLS); **IROQUOIS CO.**, E edge of Iroquois Co. State Conservation Area, *Philipee & Larrymore 33478* (ILLS); **MACON CO.**, Cowford Bridge, 23 Jun 1915, *Clokey 2325* (MO); Decatur, 1899, *Clokey 1068* (MO); **MACOUPIN CO.**, Macoupin, 2 Aug 1883, *Robertson s.n.* (ILLS); **MERCER CO.**, N of Keithsburg, 18 Aug 1951, *Evers 31940* (ILLS); **POPE CO.**, E of Dixon Springs, 10 Jun 1950, *Evers 23561* (ILLS); **PULASKI CO.**, S of Ullin, 25 Aug 1949, *Evers 19997* (ILLS); **SAINT CLAIR CO.**, near Neeleyville, 21 Aug 1896, *Eggert s.n.* (MO); **UNION CO.**, La Rue Swamp, 22 Jul 1966, *Henry 2203* (ILLS); **VERMILION CO.**, Middle Fork of Vermilion River 0.5 mile W of Kinney's Ford, 23 May 1991, *Philipe 18891* (ILLS); **WABASH CO.**, SW of Cowling, 24 Aug 1949, *Evers 19843* (ILLS); **WASHINGTON CO.**, IL 177 at Venedy, 26 Jun 1993, *Basinger & Giedeman 5677* (ILLS).

INDIANA: POSEY CO., in a pond in a low flat pin oak woods ca. 9 mi. SW of Mt. Vernon, 22 Sep 1934, *Deam 55701* (MICH); swale in wet pin oak woods, 9 mi SW of Mt. Vernon, 4 Jun 1934, *Hermann 6099* (MICH); **WELLS CO.**, Lancaster, 20 Jul 1902, *Deam s.n.* (MO).

LOUISIANA: JEFFERSON PARISH, Gretna, opposite New Orleans, 3 May 1899, *Ball 337* (MO).

MICHIGAN: OAKLAND CO., Rochester-Utica State Recreation Area, Bloomer Unit, 8 Jul 1987, *Scofield s.n.* (MO).

MISSISSIPPI: COAHOMA CO., 2 mi E of Lula, 19 Jun 1959, *McDaniel 1146* (UNA); **PEARL RIVER CO.**, 3 mi W of Picayune, 27 Jun 1967, *Sargent 13763* (MISS); **SIMPSON CO.**, D'Lo NW of Mendenhall, 10 May 1967, *Reynolds 12163* (MISS).

MISSOURI: BARTON CO., Rt. 126 at jct. with Rt. 71, 21 Jun 1978, *Castaner 5833* (MO); **BUTLER CO.**, S side Rt. 142, just W of Neeleyville, 3 Aug 1997, *Summers et al. 8283* (MO); **CAPE GIRARDEAU CO.**, 6 mi W of Delta, 24 Jun 1997, *Summers & Salvetter 8184* (MO); **CHARITON CO.**, along US Rt. 24 8 mi E of Brunswick, 1 Jul 1966, *Henderson 66-568* (MO); **DUNKLIN CO.**, White Oak, 17 Jul 1895, *Bush 691* (MO); **HENRY CO.**, 4 mi SE of Blairstown, Big Creek, 25 Jun 1979, *Castaner 5833* (MO); **JACKSON CO.**, Atherton, 7 Jul 1896, *Bush 556* (MO); **LINCOLN CO.**, Kings Lake, 16 Aug 1922, *Kellogg s.n.* (MO); **MERCER CO.**, Lowry Marsh Conservation Area, 25 Jun 1998, *Jacobs 98-84* (MO); **MISSISSIPPI CO.**, along MO Rt. 80, 23 Jun 1983, *Heineke 3194* (MO); **PEMISCOT CO.**, 7 mi S of Portageville, 22 Aug 1933, *Steyermark 9125* (MO); **RIPLEY CO.**, Sand Ponds Area, Nature Conservancy Preserve, 21 Aug 1994, *Hudson 557* (MO); **SCOTLAND CO.**, Middle Fabius River 0.5 mi S of MO Rt. M, 10 Sep 1986, *Brant & O'Donnell 984* (MO); **STODDARD CO.**, Panther Swamp, 4.5 mi NE of Dexter, 21 Aug 1954, *Steyermark 76841* (MO).

NEW JERSEY: SUSSEX CO., Andover Junction, 26 Jun 1910, *Mackenzie 4673* (MO).

NEW YORK: YATES CO., Penn Yan, s.d., *Sartwell s.n.* (MO).

OHIO: CUYAHOGA CO., Berea, 17 Jun 1997, *Watson s.n.* (MO).

OKLAHOMA: McCURTAIN CO., Barney Ward Lake, 2 mi W of Tom, 22 Jul 1972, *Taylor & Taylor 11119* (MO).

TENNESSEE: DICKSON CO., along US Rt. 70 ca. 5 mi E of Dickson, 27 Jun 1975, *Kral 56007* (MO); **LOUDON CO.**, Lenoir City, 26 May 1934, *Sharp & Underwood 1090* (MO).

TEXAS: BRAZOS CO., College Station, s.d., *Neally 2190* (MO); **HOUSTON CO.**, Big

Slough Wilderness Road, NW of Ratcliff, Davy Crockett N.F., 29 Sep 1990, *Jones & Wipff 5825* (MO); **MONTGOMERY CO.,** Horsepen Branch SE of W.G.Jones State Forest, 16 Jul 1992, *Jones & Griffin 9188* (MO).

VERMONT: CHITTENDEN CO., swampy shore of Lake Champlain, 6 Sep 1879, *Pringle 15061* (MO).

WEST VIRGINIA: BARBOUR CO., near Elk Creek in the Overfield area along WV Rt. 57, 24 Jun 1995, *Grafton s.n.* (CHSC); **GREENBRIER CO.**, mouth of Otter Creek, 16 Sep 1983, Brant 442 (MO).

APPENDIX 2.

The Historic Distribution of *Carex lupuliformis* in the United States. Information obtained from herbarium specimens and the literature. (If in > 10 counties, then only number of counties included.)

STATE	COUNTIES	NOTES
Alabama	Greene	(W-1).
Arkansas	Franklin, Logan, Monroe, Randolph, Washington	(W-1) [Note: included within *C. lupulina* by Smith (1978)].
Connecticut	Fairfield, Hartford, Litchfield, Middlesex, New Haven	(W-1; W-2); Magee & Ahles 1999. All historic, no extant sites known (W-2), but said to be extant by Thompson and Paris (2004).
Delaware	Kent, New Castle	(W-1).
Florida	44 counties, fewest in western panhandle and extreme southeast of state	(W-1; W-10).
Georgia	Unknown, none verified	(W-1) included on Plant Watch List (Georgia Natural Heritage Program 2003)
Illinois	38-46 counties, widely scattered but mostly central and southern. [38 shown in W-1 – Alexander, Brown, Cass, Champaign, Cook, Cumberland, DeKalb, DuPage, Edwards, Greene, Hamilton, Hancock, Hardin, Henry, Jackson, Johnson, Lawrence, Macoupin, Mason, Massac, Mercer, Monroe, Morgan, Peoria, Piatt, Pulaski, Richland, Saint Clair, Saline, Sangamon, Schuyler, Shelby, Union, Wayne, White, Will, Winnebago, Woodford]	(W-1); Mohlenbrock & Ladd (1978); includes Shawnee N.F. Many of these records are thought to be misidentifications of *C. gigantea* or *C. lupulina* (W-2).
Indiana	Daviess, *Hamilton, *Jefferson, *Jennings, LaGrange, *Marion, *Montgomery, *Newton, *Posey, *Saint Joseph, Wabash, *Washington, *Wayne, *Wells	(W-1; W-2); *Deam (1940).
Iowa	Southern tier of counties	(W-2; W-12); none seen since 1931.
Kentucky	10-12 counties, northern and western	(W-1); includes Daniel Boone N.F.

Louisiana	Ascension, Lincoln, Livingston, Morehouse, St. Charles, St. Mary, St. Tammany, Union, West Carroll, Winn Parishes	(W-1); MacRoberts (1989); Thomas and Allen (1993).
Maine	Unknown – none verified	(W-2); Thompson and Paris 2004
Maryland	Anne Arundel, Carolina, Cecil, Charles, Montgomery, Queen Annes	(W-2).
Massachusetts	Bristol, Franklin, Hampden, Hampshire, Worcester	Magee and Ahles (1999). 3 extant occurrences (Thompson and Paris 2004).
Michigan	Bay, Cass, Genesee, Gratiot, Hillsdale, Ingham, Kalamazoo, Macomb, Oakland, Saint Joseph, Washtenaw	(W-1; W-2); Voss (1972). Includes Isle Royale N.P.
Minnesota	Unknown – none verified	(W-2); Thompson and Paris 2004
Mississippi	Coahoma, Pearl River, Simpson	(W-1). Herbarium specimens.
Missouri	16 counties, widely scattered, concentrated in southeast ¼ of state	(W-1); Yatskievych (1999); including Mark Twain N.F.
New Jersey	10 counties, concentrated in northern half of state	(W-1).
New York	25 counties, widely scattered	(W-1).
North Carolina	Brunswick, Craven, Forsyth, Granville, Jones, Pamlico	(W-1; W-2); Radford *et al.* (1968); Herbarium specimens.
Ohio	10 counties, concentrated in north-central part of state	(W-1).
Oklahoma	McCurtain	Herbarium specimen
Pennsylvania	11 counties, widely scattered, mostly NW and SE parts of state	(W-1); Wherry *et al.* (1979); Rhoads and Block (2000).
South Carolina	Colleton, Jasper, Sumter	(W-1); Radford *et al.* (1968); Herbarium specimens.
Tennessee	10 counties, mostly east-central part of state	(W-1); Chester *et al.* 1993.
Texas	Bowie, Brazoria, Brazos, Cass, Houston, Marion, Matagorda	(W-1; W-2; W-13); Includes Davy Crockett N.F.
Vermont	Addison, Chittenden, Franklin, Grand Isle, Rutland	(W-1); Magee and Ahles (1999). 12 extant and 6 historic occurrences (Thompson and Paris 2004).

Virginia	Greensville, Halifax, James City, Northampton, Southhampton, Suffolk (city), Surry, Sussex	(W-2).
Wisconsin	Adams, Columbia, Milwaukee, Racine, Taylor [includes Chequamegon National Forest], Waukesha	(W-1; W-2; W-11).

APPENDIX 3.

Natural Diversity Database Element Ranking System

Modified from: http://www.natureserve.org/explorer/ranking.htm [W-6]

Global Ranking (G)

G1
Critically imperiled world-wide. Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

G2
Imperiled world-wide. 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

G3
Vulnerable world-wide. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

G4
Apparently secure world-wide. This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

G5
Secure globally. Numerous populations exist and there is no danger overall to the security of the element.

GH
All sites are historic. The element has not been seen for at least 20 years, but suitable habitat still exists.

GX
All sites are extirpated. This element is extinct in the wild.

GXC
Extinct in the wild. Exists only in cultivation.

G1Q
Classification uncertain. The element is very rare, but there is a taxonomic question associated with it.

National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above.

Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (*i.e.*, *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

State Ranking (S)

S1
Critically imperiled. Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

S2
Imperiled. 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

S3
Vulnerable. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

S4
Apparently Secure. This rank is clearly lower than S3 but factors exist to cause some concern (*i.e.*, there is some threat, or somewhat narrow habitat).

S5
Secure. Demonstrably secure to ineradicable in the state.

SH
All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

SNR, SU, U
Reported to occur in the state. Otherwise not ranked.

SX
All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

Notes:

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.

2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between S2 and S3), and by adding a '?' to the rank (*e.g.* S2?). This represents more certainty than S2S3, but less than S2.